Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada
NSERC CRSNG

TOWARD A COUNTRY OF DISCOVERERS AND INNOVATORS FOR A COMPETITIVE AND PROSPEROUS CANADA

A Submission to the Standing Committee on Finance from the Natural Sciences and Engineering Research Council (NSERC)

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Canada

SUMMARY

NSERC works to make Canada a country of discoverers and innovators for the benefit of all Canadians. NSERC invests in people, discovery and innovation through programs that support postsecondary research and advanced training in the natural sciences and engineering. Awards are made only for excellent proposals, selected after rigorous expert review, in the context of national competitions.

NSERC supports the production and diffusion of new scientific knowledge, the training of highly skilled people, and collaborations between universities, industry, and government to increase the rate of innovation flowing into the Canadian economy. The success of Canadian industry depends on its ability to introduce competitive products, processes and services into the global marketplace. To compete, businesses need to build their research capacity and require access to both research ideas and trained people. Given the aggressive expansion of research activities in emerging economies such as China, India and Brazil, and the productivity gap with the United States, increased investments are needed to ensure Canada's ability to compete globally. NSERC must continue to increase investments in its core research and training activities while targeting additional funds to capture strategic opportunities and stimulate industry to build its research capacity.

Continued investments in a **strong research foundation** would ensure that the growing research community and new facilities and equipment are **used to their full potential.** NSERC would also double the number of students and fellows training in Canadian industrial settings and attract to Canada 700 of the best graduate students and postdoctoral fellows from around the world.

An increased ability to **seize strategic opportunities** would enable NSERC to rapidly expand research, training, and innovation in areas in which Canada is already, or has the potential to become, a recognized world leader. Strategic partnerships provide a concerted means to better integrate resources across the university, industry and government research communities and focus them on a limited number of areas to ensure that Canada's highest priority research challenges are addressed. Canadian researchers would also be able to fully participate in important international S&T projects, bringing the best from abroad to Canada's leading edge centres and accessing world-class foreign facilities. The best researchers would have the resources necessary to bring their research program to a level where potential breakthroughs can be more rapidly captured and impact can be maximized.

NSERC is the federal government's most important tool to ensure that Canada's competitiveness and prosperity can continuously be built from a strong foundation of people, expertise and infrastructure for scientific and technological research and innovation. With incremental funding of $400 million by 2009-10 ($125 million in 2007-08, $250 million in 2008-09, and $400 million in 2009-10), NSERC would be able to mobilize Canada's existing human and capital resources for the social and economic benefit of all Canadians. Council would allocate the additional investment among the six priorities identified in this document to maximize their impact and benefit to Canada.

INTRODUCTION

NSERC aims to maximize the value of public investments and to advance prosperity and quality of life in Canada by supporting the creation and transfer of knowledge in the natural sciences and engineering (NSE) and by ensuring that people are trained to use and create that knowledge. NSERC has a track record of success demonstrated by sound investments reinforced by a rigorous peer review process.

With a current budget of $902.0 million[1], NSERC is the primary federal agency investing in postsecondary research and training in the natural sciences and engineering (NSE).Through its grants and scholarships programs, NSERC:

- annually funds 11,000 research professors at Canadian universities and colleges. Their discoveries advance knowledge and form the foundation of technological development by businesses as well as improvements in environmental quality and public safety. Despite its small population, Canada ranks eighth in the world for scientific knowledge production in the natural sciences and engineering (NSE) and third in the G8 for the impact of the new knowledge it creates[2].

- supports 23,000 undergraduate and graduate students and postdoctoral fellows each year. These highly skilled people form the human capital necessary for Canada's competitiveness and economic growth. NSE graduates have among the lowest unemployment rates and highest salaries in the country[3].

- supports university-industry research collaborations and training through partnerships with 1,300 Canadian businesses. Participating companies report a wide range of benefits from these collaborations which strengthen their ability to adopt and adapt discoveries and new technologies leading to commercial products and mobilize university researchers to address the needs of industrial users.

Virtually all aspects of modern Canadian social and economic life are affected by advances in the natural sciences and engineering. The benefits of discovery, skilled people and innovation are the foundation on which to build national prosperity, adding value to goods and services as well as developing the skilled people that are able to conduct research, generate new knowledge, access knowledge created elsewhere, and adopt and adapt new technologies for businesses.

Wealth is created by adding value in goods and services that are sold in world markets. Knowledge, created through investments in R&D, is the basis for adding value. This is well understood worldwide by both established and emerging economies. Countries like China and

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[1] This includes a base budget of $686.1 million and an additional $215.9 million that flows through NSERC for programs such as the Canada Research Chairs, Canada Graduate Scholarships, Networks of Centres of Excellence, and funding for the Perimeter Institute for Theoretical Physics.
[2] Observatoire des Sciences et des Technologies
[3] Statistics Canada and NSERC Departmental Performance Report, 2004-05, pages 23-24 (http://www.tbs-sct.gc.ca/rma/dpr1/04-05/NSERC-CRSNG/NSERC-CRSNGd45_e.asp)

India have increased their R&D expenditures as a % of GDP by 37% and 50% respectively since 2000 and have set ambitious targets to increase them even more in the coming years. In the global, knowledge-based economy, Canada faces growing competition from both established and emerging economies with excellent educational systems and a large and skilled workforce. Beyond our traditional competitors among the G8, smaller economies such as Finland, Denmark, Israel and Sweden have surpassed Canada in research intensity[4].

Currently, Canada's expenditures in R&D as a % of GDP (1.99) are lower than the OECD average (2.26). Canada ranks at or near the top however in terms of the proportion spent in the higher education sector, including the proportion that is provided by business (8.3% vs. 6.1% OECD average)[5]. These figures reflect the importance of a strong academic sector to the country; without it, our companies would lose a crucial source of knowledge and skilled people.

As a result of the significant investments made since 1997, Canada's S&T environment has been revitalized. World-class researchers are being recruited to Canadian universities[6], new research equipment and infrastructure is being installed, and many important new research projects have been launched. The momentum in Canada's research, training and innovation capacity has allowed the nation to perform above its class in international benchmarks of knowledge production and impact. Canadian students are highly sought after on the international scene and widely considered to be very well trained. Canadian researchers are welcome partners and strong contributors in international research projects[7]. There has been strong growth in the last six years in the commercialization outputs of university research[8, 9]. NSERC has also seen strong growth in the number of companies investing in its partnerships programs. Currently, more than $45M/year is invested by Canadian industry in our Collaborative Research and Development Program alone with companies contributing $1.50 for every dollar awarded by NSERC. In the current environment, where qualified people are highly mobile and competitive advantage can quickly erode, this momentum must be nurtured.

In Budget 2006, $17M in additional funding was allocated to NSERC. This enabled our Council to allocate additional funds to programs where needs were most pressing. Significantly more is needed for Canada to be competitive and prosperous in the future and secure a strong place in tomorrow's world.

TWO THRUSTS: FOUNDATION AND OPPORTUNITIES

To maintain our competitive advantage, Canada must continue to invest in both basic research and innovation for the well-being and prosperity of all Canadians. NSERC is the essential

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[4] OECD Main Science and Technology Indicators, November 2005
[5] OECD Main Science and Technology Indicators, November 2005
[6] For example, 359 researchers have been attracted from abroad to take up a Canada Research Chair (http://www.chairs.gc.ca/web/about/publications_e.asp)
[7] For example, the Neptune project in the field of oceanography (http://www.neptunecanada.ca/) led by the US and the network on ultra-fast laser science led by Japan (http://www.jsps.go.jp/english/core_to_core/outline.html) .
[8] Statistics Canada
[9] AUTM 2004 Canadian Licensing Survey (http://www.autm.net/surveys/dsp.surveyDetail.cfm?pid=28)

organization, positioned as an innovative leader, to make Canada a country of discoverers and innovators.

Strong Research Foundation Used to its Full Potential

Countries around the world are recognizing more and more the importance of a strong base of research excellence and a highly educated workforce to compete successfully in today's world. There are numerous examples of such countries, including the United States, based on its National Academies' report "Rising above the Gathering Storm"[10], and Germany[11], which has recently reviewed its science policy. Both countries (and many others such as Japan) plan to put increased emphasis, and investment, in basic research and nurturing excellence.

Canada has taken important steps to increase its investment in university research through the Granting Councils, the Canada Foundation for Innovation (CFI), the Canada Research Chairs and the Canada Graduate Scholarships. This has dramatically improved our landscape to the point that Canada is now attracting the best and brightest researchers to its well-equipped university laboratories, including many scientists and engineers attracted and repatriated from other countries. We must exploit our comparative advantage to ensure that these people have the resources to compete at the international level, and are able to attract the very best students from around the world. The best researchers are highly mobile, and will go to countries that offer them the best conditions for success. There remain some gaps that need to be filled to ensure that the Canadian research environment is optimal.

1) Growth of the Research Community

The number of scientists and engineers active in research has been growing rapidly since 1998. This is great news for Canada as it means our research capacity is building. In the last Discovery Grants competition, NSERC received funding applications from more than 800 first-time applicants, including 48 new Canada Research Chairholders. These well-qualified researchers need research funding to be able to contribute to the creation of new knowledge and discoveries, and to help educate the next generation of scientists and engineers. NSERC does not currently have the resources to give these people adequate support. The average grant size has remained unchanged for the last seven years, even though the cost of conducting research has escalated.

Additional investments of $15M/year for the next three years would support 600 new applicants every year with an average grant of $25,000/year.

2) Research Facilities and Equipment

Researchers need access to well-equipped laboratories and other research resources to conduct their research. The CFI has put in place many world-class facilities across the country, but covers only a fraction of the operating expenses required to run them, and only for a limited time (3-5 years). Many investments require significant and long term commitments: the Canadian

[10] http://www.nap.edu/catalog/11463.html
[11] Science, Vol. 313 14 July 2006.

Light Source in Saskatoon, the Sudbury Neutrino Observatory and the Neptune Project on the west coast[12] are just a few but among the largest. In addition, while CFI is very effective in supporting the acquisition of large pieces of equipment and the creation of new laboratories, it still falls to NSERC to support the purchase, replacement and maintenance of the large number of smaller tools and instruments that run all day, every day, in thousands of academic research labs across the country.

Additional investments of $60M by 2009-10 would support 40% of the requests made by researchers for the tools and instruments they need every day and would ensure that research facilities operate at full potential.

3) A Highly Skilled Workforce

Canada needs a workforce which is both highly educated, and skilled in the natural sciences and engineering for it to compete in the knowledge economy. Such people are trained in university laboratories by our scientists and engineers, using NSERC's scholarship and training programs and research support.

Canada ranks low in terms of the percentage of the 30-34 year old population holding a doctoral degree in the NSE[13]. The gap with the U.S. at the master's and doctoral levels was noted in the recent report of the Institute for Competitiveness and Prosperity as a factor that negatively affects Canadian productivity[14]. Given our small population base and the increased reliance on human talent for economic development, Canada needs to ensure that every individual has the opportunity to develop to his/her full potential.

One of the key findings of the Expert Panel on Commercialization[15] was the importance of human capital to Canada's innovation performance. There is a growing recognition that new and talented researchers require, as well as advanced scientific and engineering training, the appropriate professional skills – such as project management, marketing, the ability to work in teams, intellectual property management, and financial analysis – to translate new discoveries from home and from around the world into economic and social benefits for Canadians.

NSERC already has programs that help provide those skills, starting at the undergraduate level where our Undergraduate Student Research awards provide a rich initial research experience in an industrial or university laboratory. NSERC's university-industry partnerships and industry-based scholarships and fellowships at the graduate level produce skilled people who are eagerly hired by companies, thereby increasing Canada's research capacity in the private sector: for example, 60% of the fellows supported by these programs are employed by the sponsor company after the award is completed. Increased resources will allow us to produce many more such skilled people.

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[12] http://www.sno.phy.queensu.ca/, http://www.lightsource.ca/, http://www.neptunecanada.ca/
[13] National Science Foundation and OECD
[14] Institute for Competitiveness and Prosperity, Rebalancing priorities for Canada's prosperity, March 2006
[15] *People and Excellence: The Heart of Successful Commercialization, April 2006* (http://strategis.ic.gc.ca/epic/internet/inepc-gdc.nsf/en/tq00068e.html)

NSERC's scholarship and fellowship programs are currently for Canadian students and permanent residents only. However, the potential source of skilled people is likely to be insufficient within Canada. We plan to tap into the best and brightest of students from around the world through a prestigious scholarship program that will act as a lighthouse to attract the most excellent to come study and work in Canada. Many will decide to stay and use their skills here. Those that return will retain important linkages and contacts that we can exploit.

Additional investments of $90M/year by 2009-10 would double the number of students and fellows training in Canadian industrial settings and would provide support to attract to Canada 700 of the best graduate students and postdoctoral fellows from around the world.

Strategic Opportunities

A strong foundation is not enough. With the rapid pace of new scientific breakthroughs, many countries pursue a selective strategy aimed at focusing efforts on a few areas where they can achieve leadership and impact. Canada too must compete globally, but it is clear that we cannot be research and business leaders in all fields. Building upon a broad base of research excellence, Canada must target some of its resources on areas where it has the potential to achieve maximum impact and world-class status.

NSERC is already targeting a significant portion (11%) of its budget toward strategic opportunities but additional investments are needed in the budget to be able to rapidly expand research, training, and innovation in emerging strategic areas. Our capacity to compete at the world scale rests on our ability to form strong strategic partnerships, both at home and internationally so as to integrate research expertise and resources for increased benefits and maximum impact.

The investment of significant funds will enable Canadian researchers to seize the significant research opportunities that will lead to a greater impact for their work and enable Canada to play a major role in subsequent innovation. NSERC plans to target new investments on three fronts:

1) Strategic Partnerships

Canada's future prosperity in the competitive world depends upon our ability to establish a research and business leadership position in key areas. Increased partnerships and strategic investments through NSERC will strengthen Canada's competitive position in the global economy.

NSERC is well-positioned to identify and prioritize strategic investments in emerging platforms such as quantum computing, nanotechnology, and proteomics, and other areas of strategic importance to the country.

The workshops, projects, and networks of the Strategic Partnership Programs (SPP) of NSERC provide a concerted means to focus resources on a limited number of areas ensuring that Canada's highest priority research challenges are addressed and that we develop the research

talent we will need to compete in the knowledge-based economy. NSERC's Strategic Partnerships and Innovation Platforms accelerate research and training in targeted areas that can strongly enhance Canada's economy, society and/or environment within the next ten years. Seven new target areas were launched in January 2006: Advanced Communications and Management of Information; Biomedical Technologies; Competitive Manufacturing and Value-Added Products and Processes; Healthy Environment and Ecosystems; Quality Foods and Novel Bioproducts; Safety and Security; and Sustainable Energy Systems. These areas were selected following a year and a half of extensive consultations with key stakeholders - senior university researchers, industry representatives and government and non-governmental researchers, research managers and policy leaders - and analysis of other national and international strategies and reports.

The involvement of partners is not only key to translating the research results into applications, it is a central part of NSERC's strategy for alignment, to better integrate resources across the university, industry and government research communities and thus build the critical mass of human and physical infrastructure necessary to address complex research challenges. NSERC's new Regional Offices are also an important tool in building partnerships, promoting the participation of all regions in these efforts and encouraging companies across Canada to become partners in the initiatives.

Additional investments of $115M by 2009-10 would enable NSERC to support 40-50% of the projects submitted under its Strategic Partnerships program and to promote the creation of a significant number of new partnerships between the academic, government and industrial sectors in Canada.

2) International S&T

The significant federal investments in university research and training since 1997 have been very successful in re-establishing Canada's reputation worldwide as a key player in research and innovation. While Canadians already collaborate on a number of high-profile international projects, NSERC sees a unique opportunity to build on this success so that Canadian researchers and students may fully participate in international research projects, bring the best from abroad to Canada's leading edge centres and access world-class foreign research facilities. This is critical, as Canada performs only three per cent of the world's research activity and generates four per cent of the world's scientific knowledge[16]. We need to access the other 96%. NSERC is currently developing an International Strategy that will position Canada as a Lighthouse for international collaboration.

Here again focus is important and efforts must be targeted to areas of strength and importance to Canada, and to countries with whom enhanced collaborations will bring maximum benefits.

NSERC created the Special Research Opportunities (SRO) program in 2003 as a main vehicle through which opportunities for international collaborations could be pursued. This responsive

[16] OECD, Observatoire des Sciences et des Technologies and NSERC Departmental Performance Report 2004-05, Figures 3 and 16: http://www.tbs-sct.gc.ca/rma/dpr1/04-05/NSERC-CRSNG/NSERC-CRSNGd45_e.asp

program enables researchers to pursue emerging research opportunities at the time they become apparent, or investigate and develop collaborations to respond to national and international research opportunities. Through this program, NSERC can also issue targeted calls for proposals, for example, to participate in a multi-agency collaborative research effort, or one-time scientific opportunities such as the International Polar Year.

In the last four years, NSERC has increased the budget of the SRO program by $12M. The Networks of Centres of Excellence program has also recently launched the International Partnership Initiative which will provide existing networks with additional support to develop and enhance linkages with the best centres of excellence in the rest of the world. But more needs to be done. NSERC currently spends about 5% of its budget on international activities. Comparatively, the National Science Foundation in the U.S. devotes 10%. In Germany, the U.S. and other countries, flexibility is built into the budget to ensure that opportunities can be seized. Pressures on the SRO program and new demands have meant that the budget is fully committed too early in the fiscal year. This lack of flexibility results in Canadian researchers being unable to participate in important international S&T projects. Canadian students and fellows also do not have the same opportunities as their counterparts in other countries with regards to accessing funds to support travel to a foreign lab or facility. The benefit of supporting international travel and exchanges for large numbers of Canadian students is threefold: first, students gain valuable research experience at world-class research organizations and learn novel research techniques; second, by collaborating with international counterparts, Canadian professors and students are able to develop a network of potential future collaborators and access the new discoveries and knowledge created by researchers outside Canada; finally, some students who travel abroad to work and study at world-class facilities can become effective marketers for Canadian innovations around the world.

Additional investments of $75M/year by 2009-10 would give NSERC the resources and flexibility to support at least 30% of the opportunities for significant international partnerships in areas of strength and importance to Canada and would enable us to create opportunities to support our best research teams and centres at levels on par with the best in the world.

3) Accelerator Grants

NSERC's Discovery Grants provide baseline funding to a wide base of Canadian researchers to launch and conduct their research program. The level of the average grant (~$31,000/year) has remained virtually unchanged in recent years and current funding levels are not sufficient for most grantees to perform at full capacity; the vast majority leverage their grant through other sources. Each year, a select group reach a key point in their work when a substantial boost in funding would enable them to rapidly and significantly increase their impact.

NSERC is launching a new initiative to provide substantial resources to a small group of outstanding researchers. The increase will be highly targeted to researchers of "super star calibre" who have a well established research program and who are on the verge of a significant breakthrough in their field but who are being held back by insufficient funds.

The amount proposed for these Accelerator Grants is substantial enough to make a real difference in the research capacity of those who receive one. The intent is to provide recipients with the means to hire a postdoctoral fellow, a technician or 2-3 students, and have the resources to compete on par with the best in the world.

Additional investments of $15M/year by 2009-10 would give 5% of grantees a supplement of $40,000/year to ensure that they bring their research program to a level where potential breakthroughs can be more rapidly captured and impact can be maximized.

PROPOSED NEW INVESTMENTS

An estimate of the investment needed to fund the six initiatives described in this brief is presented below. By 2009-10, an additional $400M per year in NSERC funding would be required.

NSERC Budget Request

Investment	2007-08	2008-09	2009-10
Foundation			
Growth of the Research Community	15,000,000	30,000,000	45,000,000
Research Facilities and Equipment	30,000,000	45,000,000	60,000,000
A Highly Skilled Workforce	30,000,000	60,000,000	90,000,000
Subtotal	75,000,000	135,000,000	195,000,000
Strategic Opportunities			
Strategic Partnerships	22,000,000	65,000,000	115,000,000
International S&T	23,000,000	40,000,000	75,000,000
Accelerator Grants	5,000,000	10,000,000	15,000,000
Subtotal	50,000,000	115,000,000	205,000,000
Total Request	**125,000,000**	**250,000,000**	**400,000,000**

CONCLUSION

NSERC provides vital support for training skilled people and generating and using new knowledge. It is an essential contributor to the overall competitiveness and prosperity agenda of the Government of Canada.

NSERC requires increased funding to fully realize the benefits of Canada's existing human and infrastructure resources for research. The momentum created since Canada began to reinvest in university research and training in 1997 must be maintained. Additional resources are necessary to ensure that our strong research foundation is used to its full potential. NSERC is also well positioned to seize key opportunities in areas of strength and strategic national importance to maximize impact and benefits. These new investments directly address Canada's competitiveness agenda, and will be important factors in improving the social and economic benefits to Canadians derived from public support of research, training, and innovation.

With incremental funding of $400 million by 2009-10, NSERC will have the means to address urgent priorities and seize strategic opportunities as they arise, and will help Canada be more competitive in today's global knowledge economy.